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$$=\frac{2}{\pi r^5}\int_0^r\int_u^r\int_0^{2\surd(r^2-w^2)}x^2dudwdx$$

$$=\frac{16}{3\pi r^5}\int_0^r\int_u^r(r^2-w^2)^{\frac{3}{2}}\,dudw$$

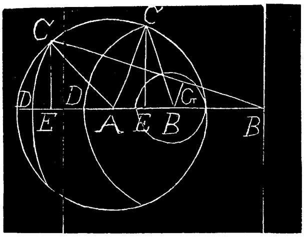
$$=\frac{1}{3\pi r^5}\int_0^r[3\pi r^4-10r^2u\surd(r^2-u^2)+4u^3\surd(r^2-u^2)-6r^4\sin^{-1}\frac{u}{r}]du$$

$$=\frac{16}{15\pi}=.3395.$$

87. **Proposed by G. B. M. ZERR, A. M., Ph. D., Professor of Science and Mathematics, Chester High School, Chester, Pa.**

Find the mean distance of a random point in a sphere from a point, (1) within, (2) without the sphere.

Solution by the PROPOSER.



Let B be the given point. $AB=c$, $AC=a$, $AD=\pm x$.

Then $DB=c-x=BC$, $CE=\surd(a^2-AE^2)$
$=\surd[(c-x)^2-(c-AE)^2]$.

$\therefore AE=\frac{(a^2+2cx-x^2)}{2c}$,

$DE=AE-x=\frac{(a^2-x^2)}{2c}$.

Area of film $CDM=2\pi DB.DE=2\pi(c-x)(a^2-x^2)/2c$.

Also let $BG=y$. Then the area of the surface of this sphere is $4\pi y^2$.

$$(1).\ \text{Distance } D=\frac{\int_{-a}^{2c-a}2\pi DB^2.DEdx+\int_0^{a-c}4\pi y^3dy}{\frac{4}{3}\pi a^3}$$

$$\therefore D=\frac{3}{4a^3c}\int_{-a}^{2c-a}(c-x)^2(a^2-x^2)dx+\frac{3}{a^3}\int_0^{a-c}y^3dy.$$

$$\therefore D=\tfrac{3}{4}a+\frac{c^2}{2a}-\frac{c^4}{20a^3}.$$

$$(2).\ D_1=\frac{\int_{-a}^{a}2\pi DB^2.DEdx}{\frac{4}{3}\pi a^3}=\frac{3}{4a^3c}\int_{-a}^{a}(c-x)^2(a^2-x^2)dx.$$

$$\therefore D_1=c+(a^2/5c).$$